WHAT IS CLAIMED IS:

1. An ultrasonic probe comprising a layered ultrasonic transducer having a first part and a second part which are adjacent to each other, wherein

each of the first part and the second part includes:

a plurality of first horizontal electrode layers and a plurality of second horizontal electrode layers alternately provided in the vertical direction;

a first vertical electrode layer electrically connected with the plurality of first horizontal electrode layers; and

a second vertical electrode layer electrically connected with the plurality of second horizontal electrode layers,

the first vertical electrode layer included in the first part and the first vertical electrode layer included in the second part being adjacent to each other via a first gap region and having the same polarity, and

the ultrasonic transducer includes a first specified structure formed by the first vertical electrode layer included in the first part, the first vertical electrode layer included in the second part, and the first gap region.

2. An ultrasonic probe according to claim 1, wherein

the ultrasonic transducer further comprises a third part adjacent to the second part,

the third part including:

a plurality of first horizontal electrode layers and a plurality of second horizontal electrode layers alternately provided in the vertical direction;

a first vertical electrode layer electrically connected with the plurality of first horizontal electrode layers; and

a second vertical electrode layer electrically connected with the plurality of second horizontal electrode layers,

the second vertical electrode layer included in the second part and the second vertical electrode layer included in the third part being adjacent to each other via a second gap region and having the same polarity, and

the ultrasonic transducer further includes a second specified structure formed by the second vertical electrode layer included in the second part, the second vertical electrode layer included in the third part, and the second gap region.

3. An ultrasonic probe according to claim 2, wherein each of the first specified structure and the second specified structure is configured symmetrically in the horizontal direction.

4. An ultrasonic probe according to claim 2, wherein the first specified structure and the second specified

structure are mutually inverted in the vertical direction.

5. An ultrasonic probe according to claim 2, wherein each of the first part, the second part, and the third part further comprises:

a piezoelectric section including the plurality of first horizontal electrode layers, the plurality of second horizontal electrode layers, and a plurality of piezoelectric layers;

first insulating means formed on one side of the piezoelectric section for insulating the first vertical electrode layer with respect to the plurality of second horizontal electrode layers; and

second insulating means formed on the other side of the piezoelectric section for insulating the second vertical electrode layer with respect to the plurality of first horizontal electrode layers.

6. An ultrasonic probe according to claim 2, wherein the first vertical electrode layer included in the first part, the second part, and the third part is one of a ground vertical electrode layer or a signal vertical electrode layer,

the second vertical electrode layer included in the first part, the second part, and the third part is the other one of a ground vertical electrode layer or a signal vertical electrode layer,

the first specified structure is one of a specified

structure for ground or a specified structure for signal, and

the second specified structure is the other one of a specified structure for ground or a specified structure for signal.

7. An ultrasonic probe according to claim 2, wherein

the ultrasonic transducer comprises a plurality of first specified structures and a plurality of second specified structures which are alternately arranged in the horizontal direction.

8. An ultrasonic probe according to claim 2, wherein

the ultrasonic transducer is an array transducer,

each of the first gap region and the second gap region has a separating slit, and

each of the first part, the second part, and the third part is a transducer element forming the array transducer.

9. An ultrasonic probe according to claim 2, wherein

each of the first part, the second part, and the third part is vertically layered and is compounded in the horizontal direction.

10. An ultrasonic probe according to claim 9, wherein

the direction of compounding is a first horizontal direction corresponding to a direction in which the first part, the second part, and the third part are arranged.

11. An ultrasonic probe according to claim 9, wherein the direction of compounding is a second horizontal direction which is orthogonal to a first horizontal direction corresponding to a direction in which the first part, the second part, and the third part are arranged.

12. An ultrasonic probe according to claim 9, wherein the direction of compounding is both a first horizontal direction corresponding to a direction in which the first part, the second part, and the third part are arranged, and a second horizontal direction which is orthogonal to the first horizontal direction.

13. An ultrasonic probe according to claim 2, wherein the ultrasonic transducer is an array transducer, the array transducer comprising a plurality of transducer elements, and each transducer element including the first part, the second part, and the third part.

14. An ultrasonic probe according to claim 13, wherein each of the transducer elements is vertically layered and is compounded in the longitudinal direction of the element.

15. An ultrasonic probe according to claim 2, wherein each of the first part, the second part, and the third part includes a piezoelectric section and a resin section which are coupled in the horizontal direction,

the piezoelectric section having a layered configuration and the resin section being formed by filling.

16. An ultrasonic probe comprising an array transducer including a plurality of transducer elements, wherein

each of the transducer elements comprises:

a plurality of first horizontal electrode layers and a plurality of second horizontal electrode layers which are provided alternately in the Z direction;

a first vertical electrode layer electrically connected with the plurality of first horizontal electrode layers; and

a second vertical electrode layer electrically connected with the plurality of second horizontal electrode layers,

the array transducer comprises a plurality of first specified structures and a plurality of second specified structures which are alternately provided in the X direction,

in each of the first specified structures, two first vertical electrode layers of two adjoining transducer elements are adjacent to each other via a first gap region, and

in each of the second specified structures, two second vertical electrode layers of two adjoining transducer elements are adjacent to each other via a second gap region.

17. An ultrasonic probe according to claim 16, wherein each of the transducer elements further comprises:

first insulating means for electrically insulating the

first vertical electrode layer with respect to the plurality of second horizontal electrode layers; and

second insulating means for electrically insulating the second vertical electrode layer with respect to the plurality of first horizontal electrode layers.

18. An ultrasonic probe according to claim 17, wherein

the first insulating means comprises a first vertical insulating layer, and

the second insulating means comprises a second vertical insulating layer.

19. An ultrasonic probe according to claim 16, wherein

each of the transducer elements has a three-layered configuration.

20. An ultrasonic probe according to claim 16, wherein

a backing including a plurality of signal lines is provided on the bottom surface side of the array transducer, end parts of the plurality of signal lines being arranged on the top surface of the backing so as to correspond to the arrangement of the plurality of transducer elements.

21. An ultrasonic probe according to claim 16, wherein

a ground member and a matching layer are provided on the top surface side of the array transducer.

22. An ultrasonic probe according to claim 16, wherein each of the transducer elements comprises at least one piezoelectric section and at least one resin section which are coupled in the Y direction which is orthogonal to the X direction.

23. An ultrasonic probe according to claim 16, wherein each of the transducer elements comprises at least one piezoelectric section and at least one resin section which are coupled in the X direction.

24. An ultrasonic probe according to claim 16, wherein each of the transducer elements comprises a plurality of piezoelectric sections and a plurality of resin sections which are coupled in the X direction and in the Y direction which is orthogonal to the X direction.

25. An ultrasonic probe comprising an array transducer including a plurality of transducer elements, wherein

each of the transducer elements comprises at least one piezoelectric section and at least one resin section which are coupled in the horizontal direction,

the at least one piezoelectric section including a plurality of piezoelectric layers and a plurality of horizontal electrode layers which are laminated in a predetermined order in the vertical direction and a pair of vertical electrode layers which are electrically connected to

the plurality of horizontal electrode layers so as to establish a predetermined connection relationship with the plurality of horizontal electrode layers,

the at least one resin section being formed as a filler layer having continuity in the vertical direction, and

each of the transducer elements is vertically layered and is compounded in the horizontal direction.

26. An ultrasonic probe according to claim 25, wherein the at least one piezoelectric section further comprises a pair of vertical insulating layers provided between both side surfaces of a piezoelectric section body formed of the plurality of piezoelectric layers and the plurality of horizontal electrode layers and the pair of vertical electrode layers.

27. An ultrasonic probe according to claim 25, wherein each of the transducer elements is compounded in one of a first horizontal direction and a second horizontal direction.

28. An ultrasonic probe according to claim 25, wherein each of the transducer elements is compounded in both a first horizontal direction and a second horizontal direction.

29. A method of manufacturing an ultrasonic probe, the method comprising the steps of:

forming a plurality of first slits on a layered assembly

having a first inner electrode member and a second inner electrode member through a top surface of the layered assembly and forming a plurality of second slits through a bottom surface of the layered assembly such that they are parallel to and alternate with the plurality of first slits;

forming a first vertical electrode layer on each side surface within each of the first silts, the first vertical electrode layer being electrically connected with the first inner electrode member and being insulated with respect to the second inner electrode member, thereby forming a plurality of first specified structures corresponding to the plurality of first silts;

forming a second vertical electrode layer on each side surface within each of the second silts, the second vertical electrode layer being electrically connected with the second inner electrode member and being insulated with respect to the first inner electrode member, thereby forming a plurality of second specified structures corresponding to the plurality of second silts; and

after formation of the plurality of first specified structures and the plurality of second specified structures, forming a plurality of separating slits on the layered assembly, thereby dividing the layered assembly into a plurality of transducer elements.

30. A method according to claim 29, further comprising the step of:

prior to formation of the plurality of first slits and the plurality of second slits, performing compounding in the horizontal direction with respect to the layered assembly.

31. A method according to claim 30, wherein

the step of performing compounding comprises the steps of:

forming a plurality of slits used for compounding in the layered assembly; and

filling the plurality of slits used for compounding with a filler material.

32. A method according to claim 29, wherein

the step of forming the plurality of first specified structures and the plurality of second specified structures comprises the step of performing compounding in the horizontal direction with respect to the layered assembly.

33. A method according to claim 32, wherein

the step of performing compounding in the horizontal direction with respect to the layered assembly is a step of filling the plurality of first slits and the plurality of second slits with a filler material used for compounding.

34. A method according to claim 29, further comprising the step of:

after formation of the plurality of first specified

structures and the plurality of second specified structures, performing compounding in the horizontal direction with respect to the layered assembly.

35. A method according to claim 34, wherein the step of performing compounding comprises the steps of:

forming a plurality of slits used for compounding in the layered assembly; and

filling the plurality of slits used for compounding with a filler material.

36. A method of manufacturing an ultrasonic probe comprising the steps of:

forming a plurality of first slits having a first depth on a layered assembly comprising a first inner electrode member and a second inner electrode member through a top surface of the layered assembly;

forming a plurality of second slits having a second depth on the layered assembly through a bottom surface of the layered assembly, such that the plurality of second slits are parallel to and alternate with the plurality of first slits;

filling the plurality of first slits and the plurality of second slits with an insulating material and hardening the insulating material;

forming a plurality of third slits by cutting through the insulating material within the plurality of first slits, the

plurality of third slits having a width which allows the insulating material which is hardened to be left on each side surface of each of the first slits and having a third depth which is greater than the first depth;

forming a plurality of fourth slits by cutting through the insulating material within the plurality of second slits, the plurality of fourth slits having a width which allows the insulating material which is hardened to be left on each side surface of each of the second slits and having a fourth depth which is greater than the second depth;

forming a first vertical electrode layer electrically connected with the first inner electrode member on each side surface of each of the third slits, thereby forming a plurality of first specified structures on the layered assembly;

forming a second vertical electrode layer electrically connected with the second inner electrode member on each side surface of each of the fourth slits, thereby forming a plurality of second specified structures on the layered assembly;

after formation of the plurality of first specified structures and the plurality of second specified structures, forming a top electrode member on a top surface of the layered assembly and forming a bottom electrode member on a bottom surface of the layered assembly;

bonding a backing to the bottom electrode member; and

after bonding of the backing, dividing the layered

assembly into a plurality of transducer elements.

37. A method according to claim 36, wherein

the step of forming the plurality of first specified structures includes a step of, after formation of the first vertical electrode layer on each side surface within each of the third slits, filling the plurality of third slits with a reinforcing material or a resin material used for compounding and hardening the material; and

the step of forming the plurality of second specified structures includes a step of, after formation of the second vertical electrode layer on each side surface within each of the fourth slits, filling the plurality of fourth slits with a reinforcing material or a resin material used for compounding and hardening the material.